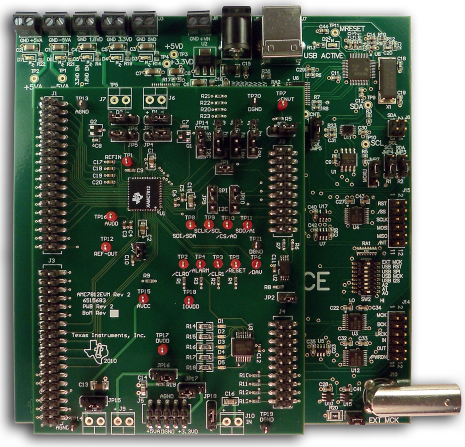
AMC7812EVM-PDK User's Guide



AMC7812EVM and AMC7812EVM-PDK

This user's guide describes the characteristics, operation, and use of the AMC7812EVM, both by itself and as part of the AMC7812EVM-PDK. The AMC7812EVM and AMC7812EVM-PDK are two evaluation fixtures for the AMC7812, an intelligent analog monitor and control circuit with a 16-channel, 12-bit analog-to-digital converter (ADC) and 12,12-bit digital-to-analog converters (DACs). A complete circuit description, schematic diagram, and bill of materials are included in this document.

The following related documents are available for download through the Texas Instruments web site at http://www.ti.com.

EVM-Related Device Data Sheets

Device	Literature Number
AMC7812	SBAS513
SN74LVC07A	SCAS595
TAS1020B	SLES025
REG1117-5	SBVS001
TPS767D318	SLVS209
SN74LVC125A	SCAS290
SN74LVC1G125	SCES223
SN74LVC1G07	SCES296
5-6k Interface Board	SLAU104

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1 EVM Overview

1.1 Features

AMC7812EVM:

- Full-featured evaluation board for the AMC7812 intelligent analog monitor and control circuit
- Modular design for use with a variety of DSP and microcontroller interface boards
- Compatible with the TI Modular EVM System

AMC7812EVM-PDK:

- Easy-to-use evaluation software for computers with Microsoft® Windows® XP operating systems
- Complete control of board settings

For use with a computer, the AMC7812EVM-PDK is a complete evaluation kit. This kit combines the AMC7812EVM with the USB-based USB-MODEVM motherboard and evaluation software.

The USB-MODEVM motherboard allows the AMC7812EVM to be connected to the computer via an available USB port. This manual shows how to use the USB-MODEVM as part of the AMC7812EVM-PDK, but does not provide technical details about the USB-MODEVM itself.

This manual covers the operation of both the AMC7812EVM and the AMC7812EVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the AMC7812EVM.

1.2 Introduction

The AMC7812 is an intelligent analog monitor and control circuit with built-in ADC, DAC, temperature sensing, and general-purpose input/output functions.

The AMC7812EVM is manufactured to Texas Instruments' modular EVM System specifications. It can be connected to any modular EVM system interface card. The AMC7812EVM allows direct evaluation of the AMC7812 performance and operating characteristics, in addition to rapid software development and system prototyping. This EVM is compatible with the 5-6k Interface Board from Texas Instruments and additional third-party boards such as the NI Speedy-33™ from National Instruments Corporation.

The AMC7812EVM-PDK is a complete evaluation and demonstration kit that includes a USB-based motherboard, the USB-MODEVM interface board. This kit also contains evaluation software for use with a personal computer equipped with Microsoft Windows NT or XP operating systems. The AMC7812EVM-PDK is a complete package that includes the following items:

- AMC7812EVM board
- USB-MODEVM board
- CD-ROM with evaluation software installer and related documentation

The AMC7812EVM is available as a standalone printed circuit board (PCB) or as part of the AMC7812EVM-PDK, which includes a USB-MODEVM motherboard and software. As a standalone PCB, the AMC7812EVM is useful for prototyping designs and firmware.

2 Analog Interface

For maximum flexibility, the AMC7812EVM is designed for easy interfacing to multiple analog sources by means of different connection options.

2.1 Remote Temperature Inputs Connection

There are two pairs of pins (four pins on the AMC7812: D1+, D1–, D2+ and D2–) that can be connected to a remote temperature sensor, such as discrete PNP or NPN transistors 2N3906 or 2N3904. On the EVM board, a 2N3904 is installed on the PCB as an input for D1+ and D1–. A 2N3906 is also installed as the temperature input for D2+ and D2–. If you would like to use a remote temperature sensor other than that installed on the board, two analog connectors J6 and J7 (not installed) can be used to route the two differential analog input signals to pins D1+/D1– and D2+/D2– on the AMC7812.

NOTE: The jumpers JP3/JP4 should be moved to position 1-2 (from the default position 2-3) so that the onboard 2N3904 can be disconnected if J6 is connected to an external remote sensor. Additionally, the jumpers at JP5 and JP6 should be moved to position 1-2 so that the onboard 2N3906 is disconnected if J7 is connected to an external remote sensor.

2.2 ADC Input Connections

The AMC7812 features a 12-bit, successive-approximation register (SAR) ADC, and a 16-channel multiplexer (mux) that can be programmed to route any one of the 16 channel analog signals to the ADC, in one of several available input modes: fully differential, pseudo-differential, or single-ended.

Samtec part numbers TSM-118-01-T-DV-P and SSW-110-22-F-D-VS-K provide a convenient 18-pin header/10-pin socket combination at J1. This header/socket provides access to the ADC related outputs and related pins of the AMC7812. Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. Table 1 summarizes the pinouts for the ADC input connector J1.

Table 1. J1: ADC Input Connector Pinout

Pin Number	Signal	Description
J1-2	$A_{IN}0$	Analog input Ch 0
J1-4	$A_{IN}1$	Analog input Ch 1
J1-6	$A_{IN}2$	Analog input Ch 2
J1-8	$A_{IN}3$	Analog input Ch 3
J1-10	$A_{IN}4$	Analog input Ch 4
J1-12	$A_{IN}5$	Analog input Ch 5
J1-14	$A_{IN}6$	Analog input Ch 6
J1-16	$A_{IN}7$	Analog input Ch 7
J1-18	$A_{IN}8$	Analog input Ch 8
J1-20	$A_{IN}9$	Analog input Ch 9
J1-22	$A_{IN}10$	Analog input Ch 10
J1-24	$A_{IN}11$	Analog input Ch 11
J1-26	$A_{IN}12$	Analog input Ch 12
J1-28	$A_{IN}13$	Analog input Ch 13
J1-30	$A_{IN}14$	Analog input Ch 14
J1-32	$A_{IN}15$	Analog input Ch 15
J1-33	AGND	Analog ground
J1-35	AGND	Analog ground
J1-36	REFIN	External reference for ADC

2.3 DAC Output Connection

The AMC7812 contains 12, 12-bit DACs that provide digital control with 12 bits of resolution with an internal reference or an external reference.

Samtec part numbers TSM-118-01-T-DV-P and SSW-110-22-F-D-VS-K provide a convenient 18-pin header/10-pin socket combination at J3. This header/socket provides access to the DAC outputs and related pins of the AMC7812. Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. Table 2 describes the DAC output connector J3 pinout.

Table 2. J3: DAC Output Connector Pinout

Pin Number	Signal	Description
J3-2	DAC0_OUT	Output of DAC0
J3-4	DAC1_OUT	Output of DAC1
J3-5	DAC2_OUT	Output of DAC2
J3-8	DAC3_OUT	Output of DAC3
J3-10	DAC4_OUT	Output of DAC4
J3-12	DAC5_OUT	Output of DAC5
J3-14	DAC6_OUT	Output of DAC6
J3-16	DAC7_OUT	Output of DAC7
J3-18	DAC8_OUT	Output of DAC8
J3-20	DAC9_OUT	Output of DAC9
J3-22	DAC10_OUT	Output of DAC10
J3-24	DAC11_OUT	Output of DAC11
J3-30	REF_OUT	Internal reference output
J3-33	AGND	Analog ground
J3-35	AGND	Analog ground
J3-36	REF_DAC	External reference for DAC

3 Digital Interface

The AMC7812EVM is designed to easily interface with multiple control platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient, 10-pin, dual-row, header/socket combination at J2, described in Table 3. This header/socket provides access to the digital control and serial data pins of the AMC7812. Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options.

Table 3. J2: Digital Interface Pinout

Pin Number	Signal	Description
J2-2, J2-17 (the external digital signal can be fed to AMC either through J2-2 or J2-17, selectable through JP12)	$\overline{\text{CNVT}}$	External conversion trigger, input to AMC. The falling edge starts the ADC under the direct mode.
J2-4, J2-10, J2-18	DGND	Digital ground
J2-6	$\overline{\text{ALARM}}$	AMC global alarm, open-drain output from AMC; active low
J2-7	FSX	Chip select
J2-8	$\overline{\text{CLR0}}$	Clear DACs associated with CLR0 (refer to AMC7812 Register Map 0x56)
J2-11	DX	SPI data out
J2-12	$\overline{\text{CLR1}}$	Clear DACs associated with CLR1(refer to AMC7812 Register Map 0x57)
J2-13	DR	SPI data in

Table 3. J2: Digital Interface Pinout (continued)

Pin Number	Signal	Description
J2-14	$\overline{\text{RESET}}$	Hardware reset, input to AMC; active low
J2-15	$\overline{\text{DAV}}$	ADC data ready flag; open-drain output from AMC; active low
J2-16	SCL	I^2C™ bus serial clock
J2-20	SDA	I^2C bus serial data line

There are more digital input or output signals from the AMC that can be accessed through a second digital interface connector, J4 (Samtec part numbers SSW-110-22-F-D-VS-K and TSM- 110-01-T-DV-P). The pinout for J4 is described in Table 4.

Table 4. J4: Digital Input/Output Pinout

Pin Number	Signal	Description
J4-1 to J412	Unused	—
J4-13, J4-15, J4-17, J4-19	GPIO	General purpose input/output
J4-14, J4-16, J4-18, J4-20	DGND	Digital ground

4 Power-Supply Interface

Connector J5 provides connections to the common power bus for the AMC7812EVM power supplies. Power is supplied on the pins as listed in Table 5.

Table 5. J5: Power-Supply Pinout

Pin Number	Signal	Description
J5-1	Unused	—
J5-2	Unused	—
J5-3	+5 VA	+5-VDC analog power supply
J5-4	Unused	—
J5-5	DGND	Digital ground
J5-6	AGND	Analog ground
J5-7	Unused	—
J5-8	IOVDD	Digital interface power supply
J5-9	+3.3 VD	+3.3-VDC digital power supply
J5-10	+5 VD	+5-VDC digital power supply

Jumpers JP16 and JP17 allow different dc voltages to be selected as power supplies for the AMC. See the appended schematic and PCB silkscreen (Figure 15) for details.

The AMC7812EVM-PDK motherboard (that is, the USB-MODEVM interface board) supplies power to J5 of the AMC7812EVM. Power for the motherboard is supplied either through its USB connection or via terminal blocks on the board. Also, external power supplies can be used for the AMC7812EVM via terminal blocks J8, J9, and J10 on the AMC7812EVM board.

4.1 AMC Power Supplies

Power for the AMC7812 primary analog supply AVDD (including AVDD1 and AVDD2 power pins) and the AMC7812 core digital supply DVDD can be supplied either from the J5 connector or the J9 terminal block selected by JP16. Moreover, the voltage from the J5 connector can be either +3.3 VDC or +5 VDC, selected by JP17.

Power for the AMC7812 DAC output AVCC can be supplied either from the J5 connector or the J8 terminal block, selected by JP15. The voltage from J5 connector is +5 VDC.

Power for the AMC7812 digital interface IOVDD can be supplied either from the J5 connector or the J10 terminal block, selected by JP18. The voltage from the J5 connector is +3.3 V by default, selectable by SW3 on the motherboard.

Table 6 summarizes the power options for the AMC7812 and the AMC7812EVM. The manufacturing default power supplies to the AMC7812 are also provided in Table 6.

Table 6. AMC7812 Power-Supply Options

AMC7812 Power Pin	Power Supply Resource	Voltage Level	Default Setting
AVDD1, AVDD2	From J9 externally	2.7 V to 5.5 V	JP16 shunt on 1-2
	From J5 pin 9	+3.3 V	JP16 shunt on 2-3 JP17 shunt on 2-3
	From J5 pin 10 **(manufacturer default setting)**	+5 V	JP16 shunt on 2-3 JP17 shunt on 1-2
AVCC	From J8 externally	4.5 V to 18 V	JP15 shunt on 1-2
	From J5 pin 3 **(manufacturer default setting)**	+5 V	JP15 shunt on 2-3
DVDD	The same as AVDD	—	—
IOVDD	From J10 externally	1.65 V to 5.5 V	JP18 shunt on 2-3
	From J5 pin 8 **(manufacturer default setting)**	+3.3 V	JP18 shunt on 1-2

4.2 Standalone Operation Power

When the AMC7812EVM PCB is used as a standalone EVM, power can be applied to J8, J9, and J10.

CAUTION

Verify that all power supplies are within the safe operating limits shown in the AMC7812 data sheet (SBAS513) before applying power to the EVM.

Before an external power supply is applied to J8, J9, or J10, make sure that the corresponding selection jumper JP16, JP15, or JP18 has been properly set up. Refer to Table 6.

4.3 AMC7812EVM-PDK Operation Power

When the AMC7812EVM PCB is used as a daughterboard, power can be supplied from the connector to the motherboard through the power-supply connector, J5. Refer to Table 5.

The AMC7812EVM-PDK includes a USB-MODEVM board as the motherboard, which provides power to the AMC7812EVM board through connector J5.

Power to the motherboard USB-MODEVM board can be supplied from one of the following different sources:

- Through a USB connection
- 6.0-VDC to 10.0-VDC ac/dc external wall supply (not included)
- Laboratory power supplies

Each power-supply voltage has an LED (D1 to D7) that lights when the respective power supply is active.

When powered from the USB connection, JMP6 (on the USB-MODEVM PCB) should have a shunt from pins 1-2 (the factory default configuration). When powered from 6 VDC to 10 VDC, either through the J8 terminal block or J9 barrel jack, JMP6 should have a shunt installed on pins 2-3.

If power is applied in any of these ways, onboard regulators generate the required supply voltages, and no further power supplies are necessary.

If laboratory supplies are used to provide the individual voltages required by the USB-MODEVM interface board, JMP6 should have no shunt installed. Voltages are then applied to J2 (+5 VA), J3 (+5 VD), J4 (+1.8 VD), and J5 (+3.3 VD). The +1.8 VD and +3.3 VD also can be generated on the board, from the +5-VD supply, by the onboard regulators; to enable this supply, the switches on SW1 must be set to enable the regulators. Move the switches to the *On* position (lower position, looking at the board with text reading right-side up) to enable the regulators. If +1.8 VD and +3.3 VD are supplied externally, disable the onboard regulators by placing the SW1 switches in the *Off* position.

An IOVDD power supply matches the power voltage level with external digital devices that interface with the USB-MODEVM board. An onboard switch, SW3, can set the IOVDD voltage to be 1.2 V, 1.4 V, 1.6 V, 1.8 V, 2.0 V, 2.5 V, 3.0 V, or 3.3 V.

5 EVM Hardware Configuration

Before operation, the AMC7812EVM board may need to be set up. Figure 1 illustrates the location and orientation of the various EVM jumpers.

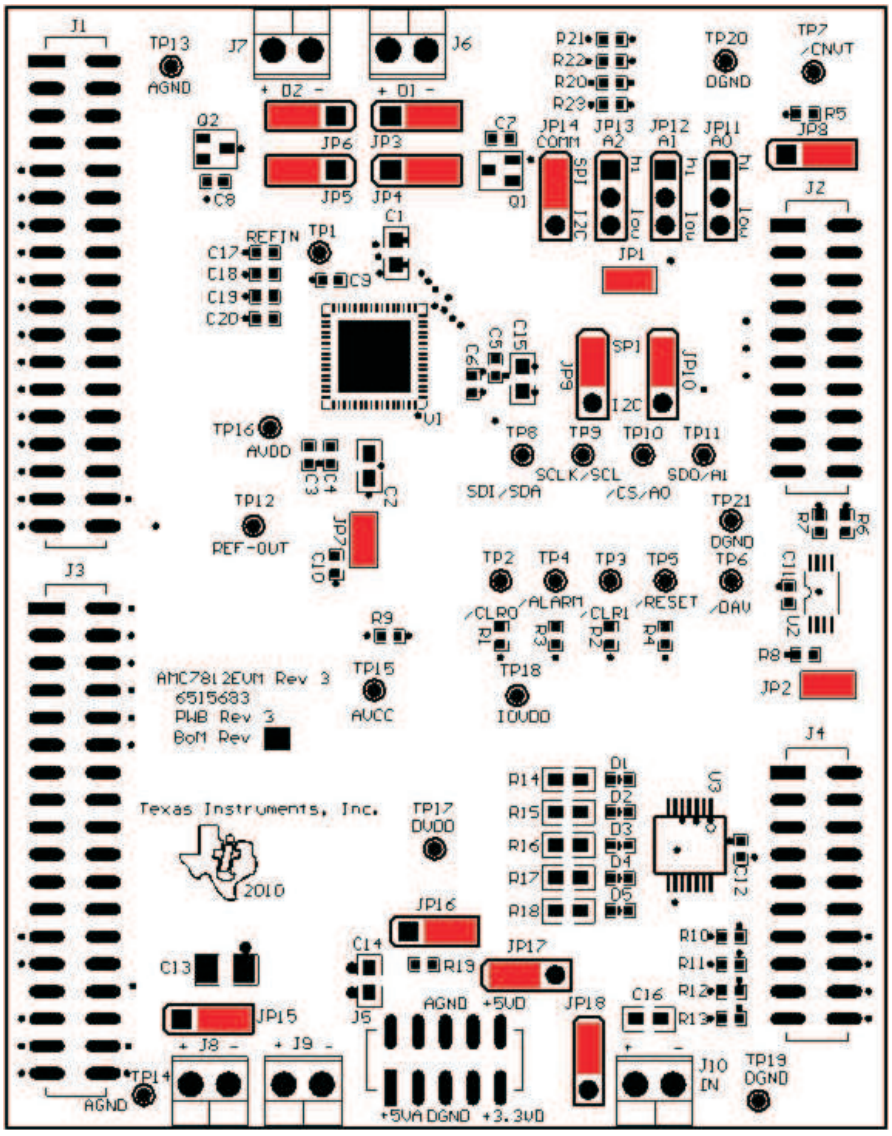


Figure 1. Default Jumper Configuration

In Figure 1, all 18 jumpers of the AMC7812EVM are highlighted in yellow. The definitions and default settings of these 18 jumpers are listed in Table 7.

Table 7. AMC7812EVM PCB Jumper Definitions and Default Positions

Jumper No	Definitions	Default Setting
JP1	Chip select: • Removed: I^2C • Installed: SPI	Installed
JP2	Address A0 setting for firmware EEPROM: • Removed: Address: 1010001 • Installed: Address: 1010000	Installed
JP3 ~ JP4	Connecting on- or off-board remote temp sensor to AMC pins D1+/D1–: • Removed: Connecting remote sensor from J6 • Installed: Connecting onboard 2N3904	Shunt on 2-3
JP5 ~ JP6	Connecting on- or off-board remote temp sensor to AMC pins D2+/D2–: • Removed: Connecting remote sensor from J7 • Installed: Connecting onboard 2N3906	Shunt on 2-3
JP7	Connecting AMC internal REF_OUT to REF-DAC: • Removed: Internal REF_OUT not connected to REF_DAC • Installed: Internal REF_OUT connected to REF_DAC	Installed
JP8	$\overline{\text{CNVT}}$ source selection:: • $\overline{\text{CNVT}}$ signal from J2-17 • $\overline{\text{CNVT}}$ signal from J2-2	Shunt on 2-3
JP9, JP14	Select I^2C or SPI Communication: • Both 1~2: SPI mode • Both 2~3: I^2C mode	Shunt on 1~2
JP10	I^2C or SPI Clock: • 1~2: SPI clock • 2~3: I^2C clock	Shunt on 1~2
JP11, JP12, JP13	Set I^2C Address. JP11 sets A0, JP12 sets A1, JP13 sets A2: • 1~2: High • 2~3: Low Set all low for use with AMC7812EVM software	Not installed
JP15	AMC VCC power resource selection: • VCC gets external supply from J8 • VCC gets +5-V supply from J5	Shunt on 2-3
JP16	AMC AVDD/DVDD power resource selection: • AVDD/DVDD gets external supply from J9 • AVDD/DVDD gets supply from J5	Shunt on 2-3
JP17	AMC AVDD/DVDD power resource selection from J5: • 1~2: AVDD/DVDD gets +5 V from J5 • 2~3: AVDD/DVDD gets +3.3 V from J5	Shunt on 1~2
JP18	AMC IOVDD power resource selection: • 1~2: IOVDD gets supply from J5 • 2~3: IOVDD gets external supply from J10	Shunt on 1~2

6 EVM Hardware Configuration

The following sections of this user guide provide information about operating the AMC7812EVM-PDK, including setup, program installation, and software use as well as its operational description.

6.1 EVM-PDK Setup

6.1.1 Hardware

The AMC7812EVM-PDK includes these components:

- AMC7812EVM board
- USB-MODEVM board
- CD-ROM with evaluation software installer and related documents

Figure 2 shows the hardware block diagram of the AMC7812EVM-PDK.

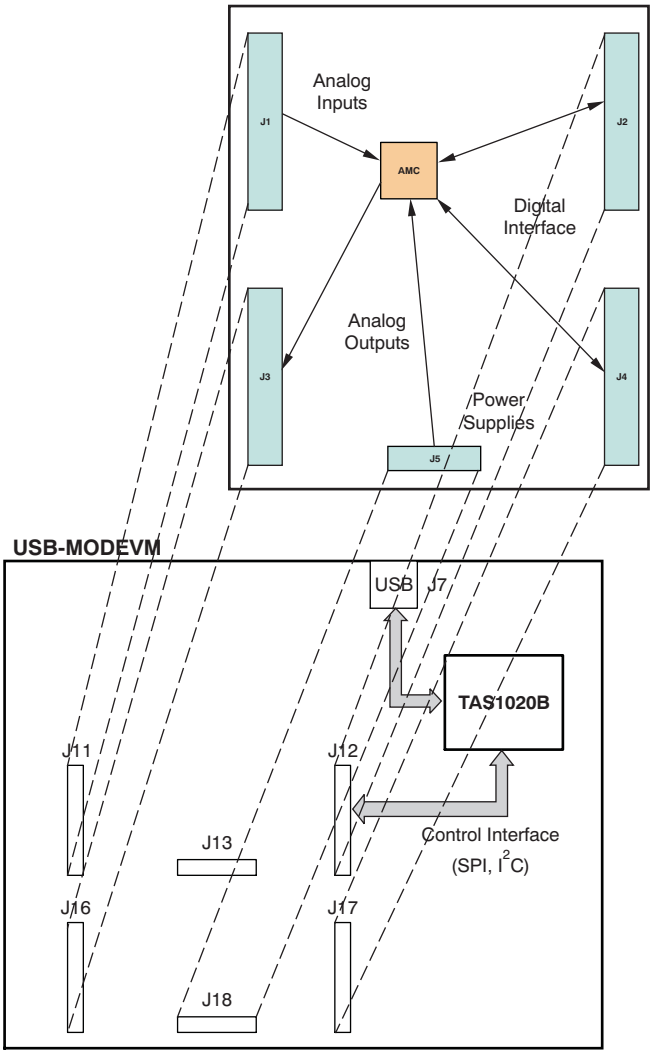


Figure 2. AMC7812EVM-PDK Hardware Block Diagram and Connections

The two PCBs are connected together; the AMC7812EVM board is seated on top of the USB-MODEVM board. Note that, as shown in Figure 2, connectors J1, J2, J3, J4, and J5 of the AMC7812EVM PCB should be plugged into J11, J12, J16, J17, and J18 of the USB-MODEVM, respectively.

All switches and jumpers on both mother- and daughterboards should remain in the respective default positions as shipped from the manufacturer, except SW2-1, which should be set to *Off*. The default jumper and switch positions for the AMC7812EVM board and the USB-MODEVM board are summarized in Table 7 and Table 8, respectively.

Table 8. USB-MODEVM Switch and Jumper Default Positions

Switch or Jumper	Setting
SW2	SW2-1 OFF
	SW2-2 ON
	SW2-3 ON
	SW2-4 ON
	SW2-5 ON
	SW2-6 ON
	SW2-7 ON
	SW2-8 OFF
SW3	SW3-1 ON
	SW3-2 OFF
	SW3-3 OFF
	SW3-4 OFF
	SW3-5 OFF
	SW3-6 OFF
	SW3-7 OFF
	SW3-8 OFF
JMP1	Installed
JMP2	Installed
JMP3	Removed
JMP4	Removed
JMP5	Shunt 2~3
JMP6	Shunt 1~2
JMP7	Shunt 2~3
JMP8	Removed

6.1.2 Software Installation

To run the AMC7812EVM-PDK, the software provided with the CD-ROM must be installed and your PC must be properly set up. Follow these installation and setup procedures.

Step 1. Go to the *Installer* directory on this CD-ROM. Locate and run *setup.exe*.

Step 2. Accept the license agreement, and continue the installation.

Step 3. Follow the instructions and prompts as they appear on-screen.

Step 4. When the installation completes, click **Finish** on the AMC7812EVM installer window.

Step 5. Restart your computer. (This step may not be necessary, but it is suggested.)

Step 6. When your computer has restarted, connect the AMC7812EVM to the computer via a USB cable. Microsoft Windows should recognize the new device, and start the *Found New Hardware* wizard sequence.

Step 7. Select **Install from a list or specific location** (Advanced), and click on *Next*>.

Step 8. Select **Don't Search. I will choose the driver to install**, and click on *Next*>. If the AMC7812EVM appears in the Model list, click on the name of the device to select it. You are done. Otherwise, continue with these steps.

Step 9. If the AMC7812EVM is not in this list, the Windows *Add Hardware* wizard provides a list of common hardware types; scroll through the list to find *NI-VISA USB Devices*. Select this option and then click on it.

Step 10. Click on *Have Disk....* Select *Browse...*, and find the file *AMC7812EVM.inf*. This file is included with the installer and should be in this directory:

C:\Program Files\Texas Instruments\AMC7812EVM \data\

Step 11. Select the *AMC7812EVM.inf* file and click on it. The PC should install it automatically.

Step 12. Click on **Finish** to complete the installation.

Once the installer has completed its processes, you are done and ready to operate the AMC7812EVM software.

6.2 Quick Start

When both the hardware and software installation and configuration processes have been successfully completed, attach a USB cable from the PC to the USB-MODEVM Interface board (J7 on the motherboard).

As configured at the factory, the USB-MODEVM board is powered from the USB interface. Therefore, no external power supply is needed, and the power indicator LEDs on the USB-MODEVM should light up. The yellow LED (D2, located next to the J7 USB plug) should light up as well.

Once the USB-MODEVM is powered on, launch the AMC7812 evaluation software that is installed on the PC. The software should automatically find the AMC7812EVM, and a dialog box similar to that shown in Figure 3 should appear.

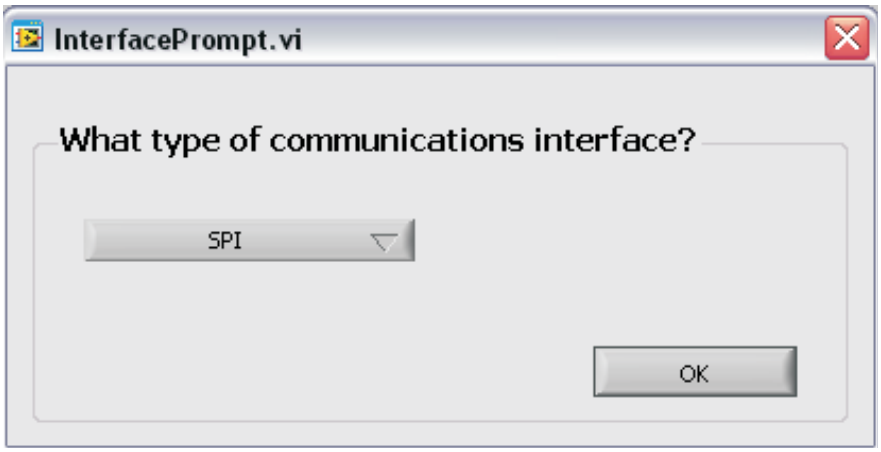


Figure 3. AMC7812 Software Communication Prompt

Select the desired communication protocol. By default, the AMC7812EVM board is setup for SPI communication.

Click on the **OK** button to continue, and the software graphical user interface (GUI) appears, as Figure 4 illustrates.

Figure 4. AMC7812EVM-PDK Software GUI: Start-Up Screen with Monitoring Temp Tab

Three temperature monitoring sections appear, with the local (or AMC7812 silicon) temperature displayed at the left section of the tab. The remote temperature to D1+/D1– input (from the onboard NPN transistor 2N3904) shows in the middle section; and another remote temperature to D2+/D2– input (from the onboard PNP transistor 2N3906) appears in the right section. The temperatures should be approximately the same as the room temperature, as Figure 4 shows.

7 GUI Software and Operating Descriptions

Once you have connected the AMC7812EVM to the USB-MODEVM motherboard and provided power to the motherboard from a USB port on your PC, start the AMC7812EVM-PDK software; correspondingly, the GUI should display (refer to Figure 4). The common software settings, controls, or display sections for the AMC7812EVM-PDK are arranged at the top and bottom of the GUI.

There are also five tabs in the middle and main section of the GUI, designed for users to easily access the registers of the AMC7812 that are specified for a particular function of the device.

7.1 Common Sections of GUI

At the top left-hand side of the GUI, the location and version of the firmware are shown (refer to Figure 4).

At the upper center of the GUI, the rectangle box labeled *Global Alarm* displays the status of the AMC7812 GALR bit. The global alarm box is dimmed unless an alarm event occurs; if this happens, the box turns red. See the AMC7812 data sheet (SBAS513) for more information about the global alarm flag GALR.

The two buttons at the upper right-hand side of the GUI can be used to perform a software reset of the AMC7812. When you click on the **SW Reset** button, the SW reset register is written to and a reset operation is implemented. See the AMC7812 data sheet (SBAS513) for more information about the software reset and SW Reset register. To stop running the EVM evaluation tool, you may either click on *File-->Exit* button or click the red X at the top of this window.

In the middle of the bottom area of the GUI, the control button can be used to turn the AMC internal reference circuitry on or off. The internal reference voltage can be measured at the test point (TP) of REF_OUT on the AMC7812EVM board; the location of this area is indicated in Figure 5.

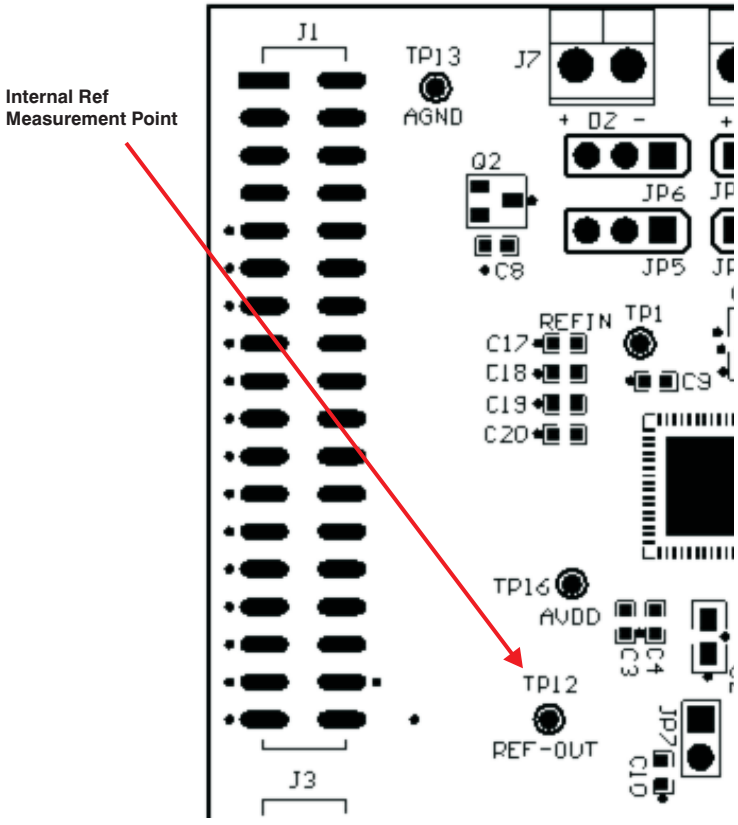


Figure 5. AMC7812 REF_OUT Pin Location

At the lower right-hand section of the GUI, there is a control button to enable or disable the auto-read function of the AMC7812 registers. If it is enabled, all registers of the AMC7812 are read continuously. The AMC registers include: temperature data, alarm data, ADC data, and DAC data. Additionally the fifth tab on the AMC7812EVM software, *Register Map* (see Figure 14), is updated with the values read. If it is disabled, the front panel does not update with any register changes on the AMC7812EVM.

7.2 AMC and Alarms Tab

This tab allows users to access or observe the AMC7812 registers and register bits related to common programmable setting and alarms of the AMC7812. Clicking on this tab brings up another display screen, as shown in Figure 6.

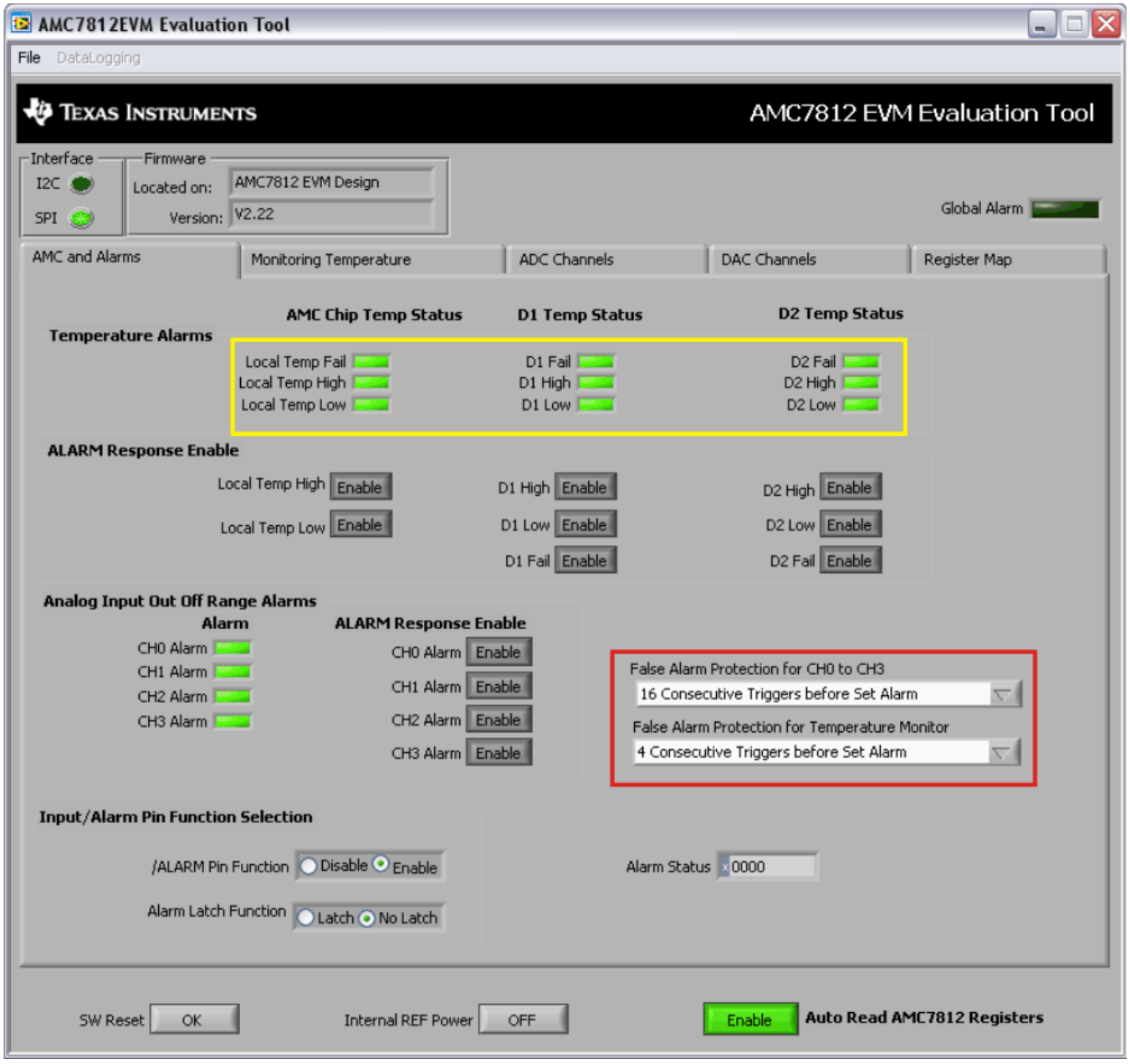


Figure 6. AMC7812EVM-PDK Software GUI: AMC and Alarms Tab

The *AMC and Alarms* tab displays alarm information for the AMC Chip Temperature, D1 Temperature, and D2 Temperature status. These indicators are highlighted with a yellow box in Figure 6. Also highlighted in Figure 6 are false alarm protection settings for each alarm that can trigger with the AMC7812; these settings allow the user to choose how many consecutive triggers must occur before the alarm goes off. Additionally, at the bottom right of this tab, there is a window for enabling/disabling the alarm pin function and alarm latch settings.

When an alarm occurs, the corresponding LED on the GUI lights up on the AMC7812EVM. Figure 7 shows AMC Chip Temperature Status triggering for a low temperature, D1 temperature status triggering for a high temperature, and D2 failing because jumper JP3 was removed to force a failure. The Global Alarm LED is also triggered because of these alarms. Additionally, *Alarm Status*, highlighted in red at the bottom right of Figure 7, shows the value of the AMC Status Register.

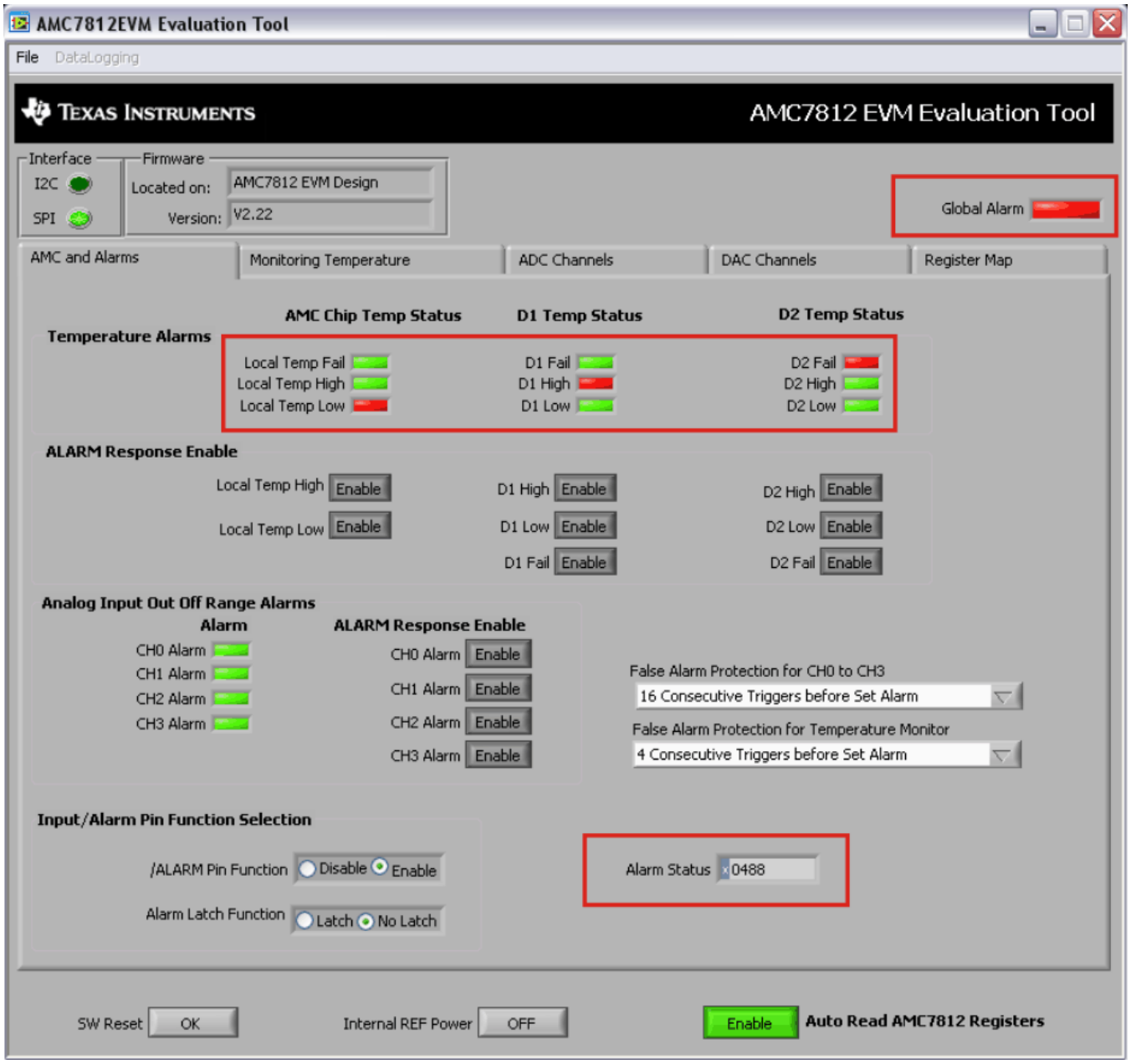


Figure 7. AMC7812EVM-PDK Software GUI: Alarms Triggered

7.3 Monitoring Temperature Tab

The AMC7812 contains one internal (also called local or AMC) temperature sensor and two temperature measurement ports D1 and D2 for sensing temperatures from external remote locations. This tab enables users to access or observe the AMC7812 registers and register bits related to the three temperature monitoring functions.

Clicking on the tab label brings up a GUI tab for monitoring temperature (Figure 4), which is also the default software tab at power-up.

There are three primary sections, each corresponding to one of the three temperature measurements: the internal/local temperature (labeled as *AMC TEMP*); the remote temperature from the AMC7812 D1 port (labeled as *D1 TEMP*); and the remote temperature from the AMC7812 D2 port (labeled as *D2 TEMP*), as shown in Figure 8.

Figure 8. AMC7812EVM-PDK Software GUI: Monitoring Temperature Tab

At the top of each temperature monitoring section, the corresponding temperature is displayed by the meter in degrees Celsius (°C). The raw data is also displayed at the top of the meter. These features are highlighted by the red box in Figure 8. The area highlighted in a yellow box is an additional control to set the conversion rate of temperature data from the AMC7812.

7.4 ADC Channels Tab

This tab provides users access to observe or modify the AMC7812 control and data registers, as well as register bits of the configurations, modes, status, and data concerning the 16 ADC channels of the AMC7812. Clicking on the *ADC Channels* tab brings up a GUI, as shown in Figure 9.

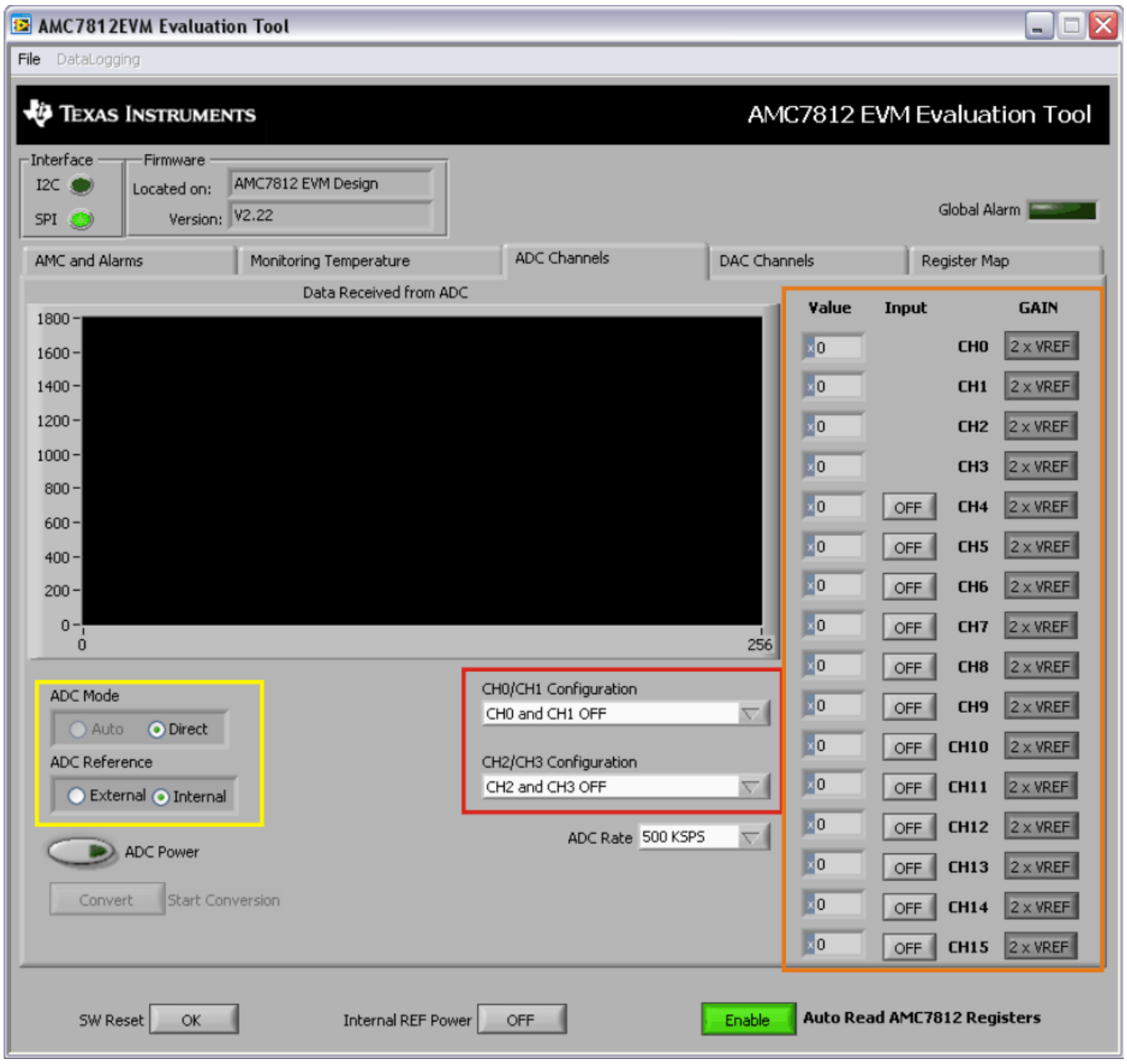


Figure 9. AMC7812EVM-PDK Software GUI: ADC Channels Tab

This tab can be grouped into three sections, as shown by the colored rectangles Figure 9. ADC reference selection can be made using the panel of settings highlighted in yellow in figure 9. Auto-mode is disabled for evaluation of the AMC7812 and direct sampling mode must be used, but emulates auto-mode by periodically sending convert start commands to the AMC7812. Located below the section highlighted in yellow is a control to turn the ADC power on or off. ADC power must be turned on to use the ADC channels of the AMC7812.

The section highlighted in red controls CH0, CH1, CH2, and CH3. CH0 and CH1 can be used for differential sampling or singled-ended sampling. CH2 and CH3 can also be used for differential sampling or single-ended sampling. Below this section is another separate control for selecting the sampling rate of the 16 ADC channels.

The last section, highlighted in orange, is used to turn on or off the upper 12 channels of the AMC7812 ADC. These channels are used as single-ended channels only. Additionally, this section of the GUI is used to modify or observe the channel gain settings.

At the bottom middle of the GUI, there is another control to turn the internal reference power on or off . If an external reference is not provided, this control must be turned on to use the AMC7812 ADC.

7.5 DAC Channels Tab

This tab allows users to access or observe the AMC7812 control and data registers, and register bits of the configurations, modes, status, and data for theDACs and the outputs of the AMC7812. Clicking on the tab *DAC Channels* brings up a screen similar to that shown in Figure 10. This tab can be grouped into four sections, as highlighted in the illustration.

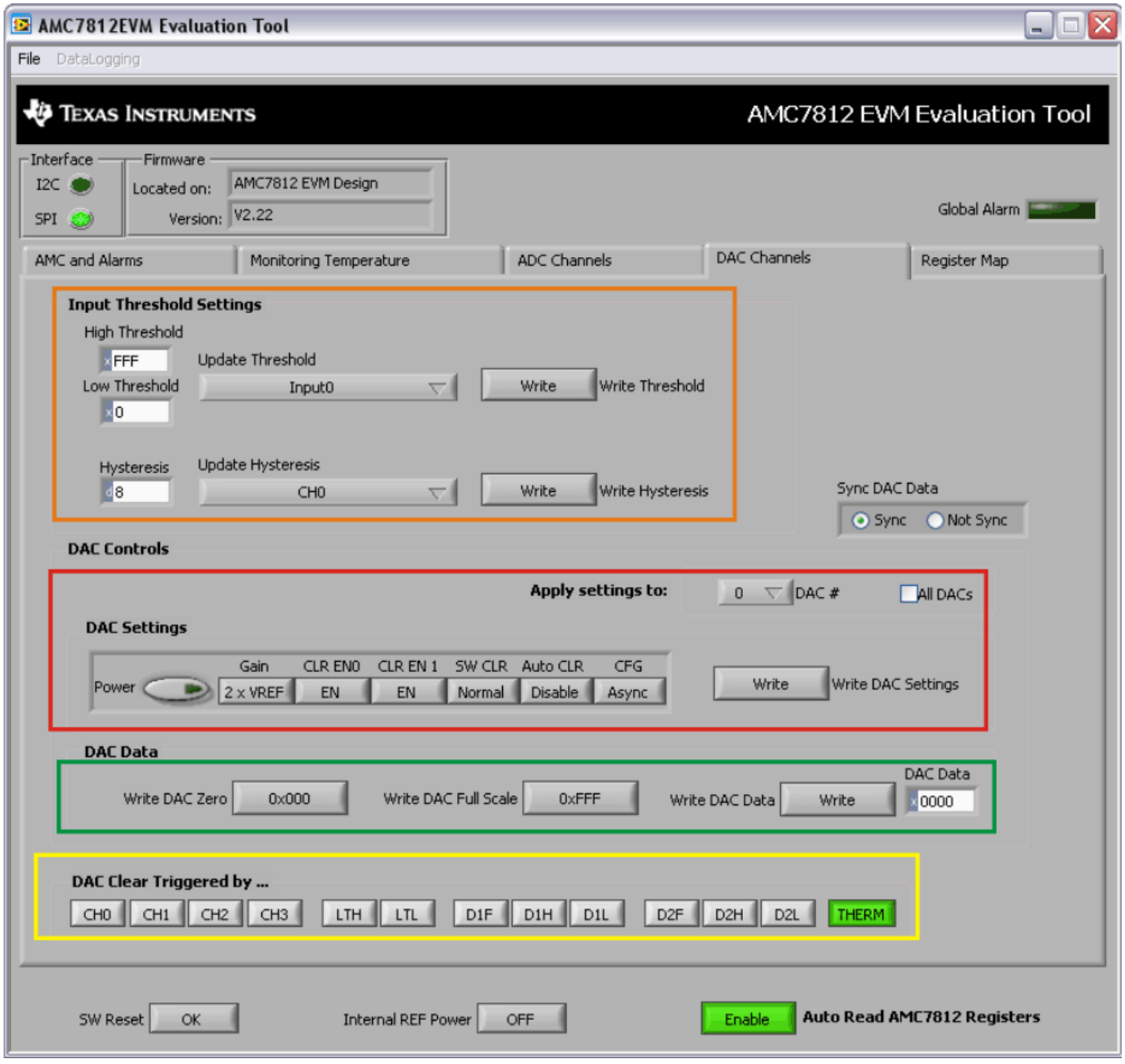


Figure 10. AMC7812EVM-PDK Software GUI: DAC Channels Tab

The first section is highlighted with the orange rectangle in Figure 10, and allows the user to make modifications to high and low threshold register settings in the AMC7812 in addition to hysteresis register settings. The second section of this tab, highlighted in red, is used to write settings to the DAC channel registers. Modifications to DAC settings can either be applied channel by channel, or to all DAC channels at the same time by using the *Apply settings to:* options also in the section of Figure 10 that is highlighted in red.

The third section, highlighted in green in Figure 10, is used to write values to the output of DAC channels. As with the DAC channel settings, data can be written channel by channel or written out to all channels by using the *Apply settings to:* settings from the section highlighted in red. Users can write zero (0x000), full-scale (0xFFF), or custom data values to each DAC channel.

The last section, highlighted in yellow, allows the user to customize what events will generate a DAC clear event. For more details concerning DAC clear functions, or any other functions of the DAC registers on the AMC7812, refer to the AMC7812 data sheet.

If the user is not using an external reference, the control for internal reference power in the middle of the GUI (at the bottom of the screen) must be turned *ON* to use the DAC channels of the AMC7812.

7.6 Cooperation of DAC and ADC Tabs: An Analog Loopback Test

A test can be implemented to test the combined performance of the AMC7812 DAC and ADC, through the cooperation of the DAC and ADC tabs discussed above, such as that shown in Figure 11.

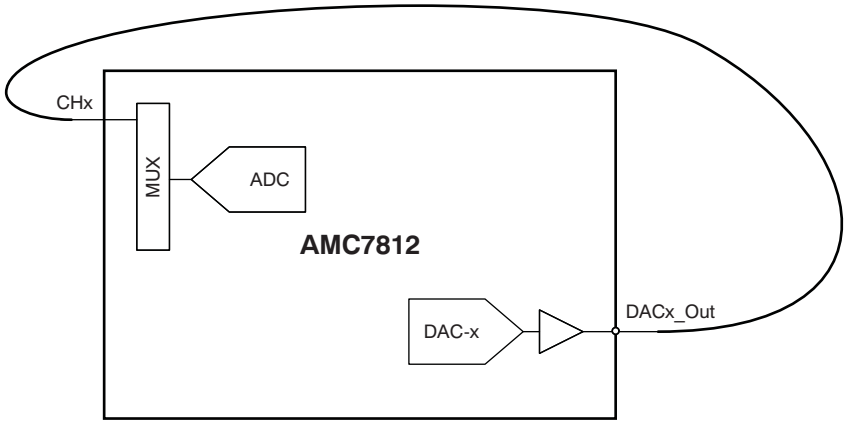


Figure 11. AMC7812 Analog Loopback Test

To implement such a test, the connection from the AMC7812 DAC output to the AMC7812 ADC input should be made as shown by Figure 12. In this example, the upper four DAC outputs were looped back to the upper four ADC channel inputs Ch0 to Ch3.

CAUTION

For the analog loopback test, the DAC signal range must be within the ADC input range.

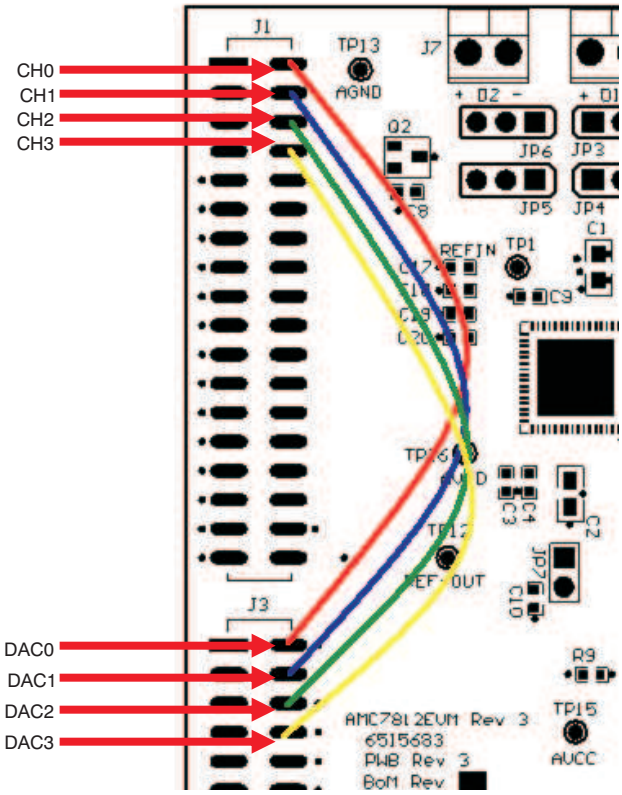


Figure 12. Connections on AMC7812EVM Board for Running Analog Loopback Test

After making the appropriate connections as illustrated in Figure 12 (in addition to making appropriate grounding connections), start the AMC7812EVM-PDK software. Using the AMC7812EVM-PDK software, first navigate to the DAC output on the DAC channels tab, and complete the following procedures.

- Power up the internal reference by clicking on the **Internal REF Power** button
- Under *DAC Settings*, turn on the power by clicking the **Power** button
- Write power on to all of the DAC registers by clicking the write button to the right of the *DAC Settings* pane with **All DACs** selected.
- Write *0x1111* to DAC0 by typing *1111* to the *Write DAC Data* field in the *DAC Data* pane
- Click the pull-down menu next to *Apply Settings to:* and select DAC1
- Repeat writing data to the DAC output, but enter *2222* for DAC1
- Click the pull-down menu next to *Apply Settings to:* and select DAC2
- Repeat writing data to the DAC output, but enter *3333* for DAC2
- Click the pull-down menu next to *Apply Settings to:* and select DAC3
- Repeat writing data to the DAC output, but enter *4444* for DAC3

Next, shift to the ADC channels tab, as shown in Figure 13. Then:

- Power up the ADC by clicking on the control next to the label **ADC Power**
- Click the pulldown menu for CH0/CH1 configuration and select *CH0 and CH1 as SE*
- Click the pulldown menu for CH2/CH3 configuration and select *CH2 and CH3 as SE*

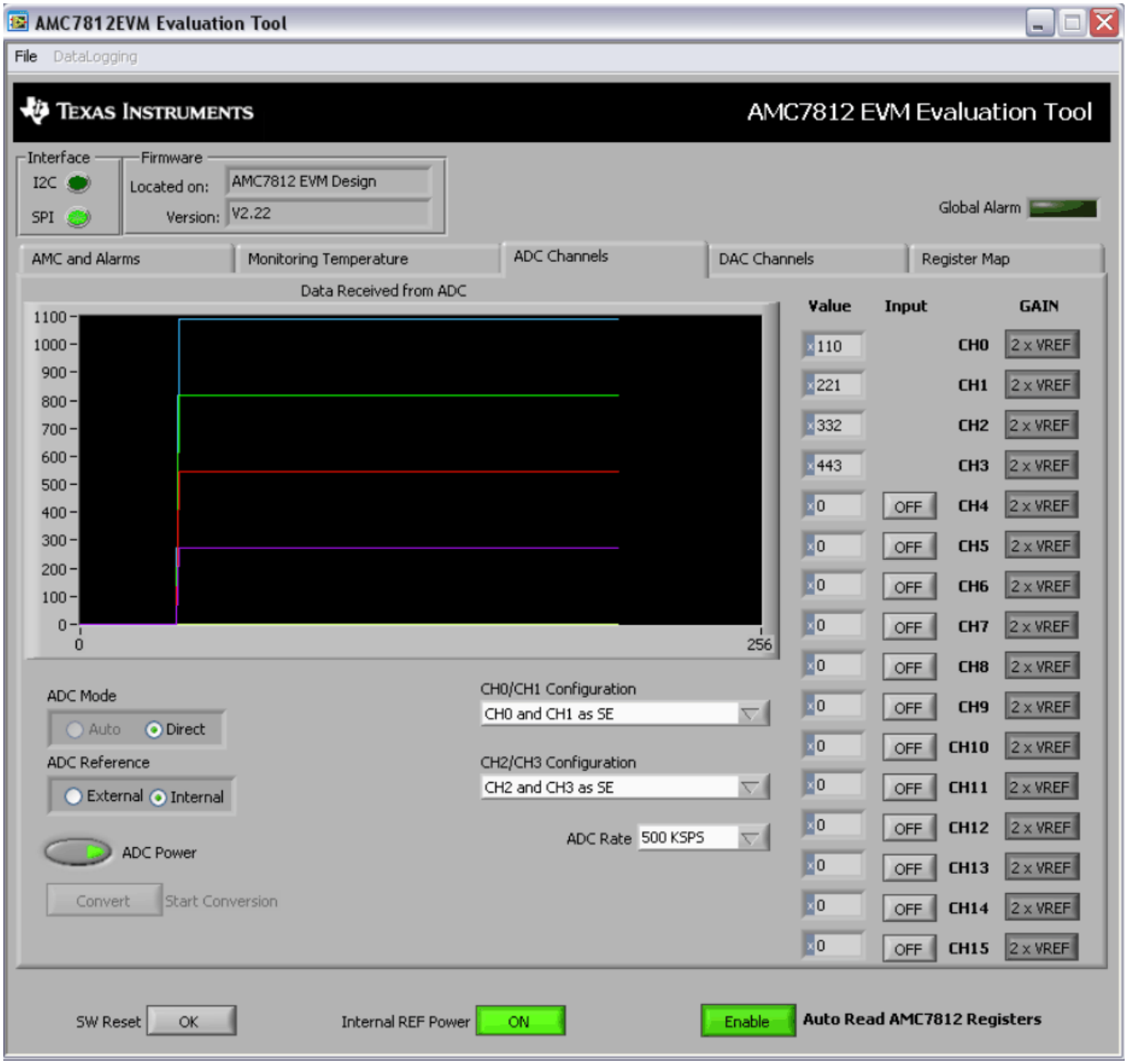
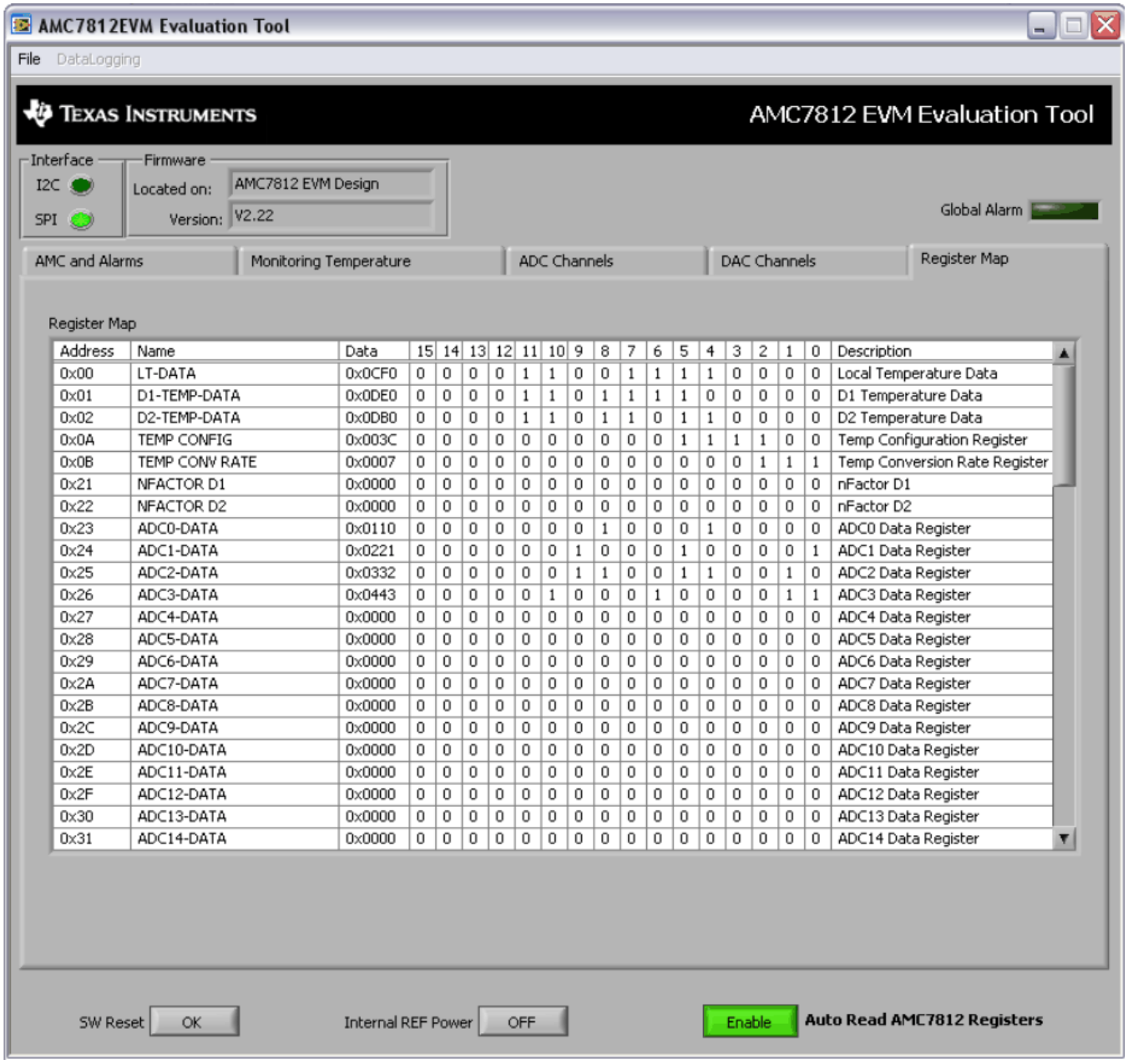


Figure 13. AMC7812EVM-PDK Software GUI: Analog Loopback Test of CH0~CH3

The digital from CH0—CH3 should now be displayed in the graphic area; the corresponding indicators on the right side of the screen should also reflect the full-scale output from the DAC channels. The resulting waveform should appear as Figure 13 illustrates.

7.7 Register Map

The Register Map tab allows users to view the Register Map of the AMC7812 and its current register settings from the AMC7812EVM-PDK software. No modifications can be made to the register settings directly from this tab, but it can be useful for debugging or assistance in understanding the operation of the part. Figure 14 shows the AMC7812EVM-PDK Register Map tab.



Address	Name	Data	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Description
0x00	LT-DATA	0x0CF0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0	Local Temperature Data
0x01	D1-TEMP-DATA	0x0DE0	0	0	0	0	1	1	0	1	1	1	1	0	0	0	0	0	D1 Temperature Data
0x02	D2-TEMP-DATA	0x0DB0	0	0	0	0	1	1	0	1	1	0	1	1	0	0	0	0	D2 Temperature Data
0x0A	TEMP CONFIG	0x003C	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	Temp Configuration Register
0x0B	TEMP CONV RATE	0x0007	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	Temp Conversion Rate Register
0x21	NFACTOR D1	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	nFactor D1
0x22	NFACTOR D2	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	nFactor D2
0x23	ADC0-DATA	0x0110	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	ADC0 Data Register
0x24	ADC1-DATA	0x0221	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	ADC1 Data Register
0x25	ADC2-DATA	0x0332	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	ADC2 Data Register
0x26	ADC3-DATA	0x0443	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	ADC3 Data Register
0x27	ADC4-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC4 Data Register
0x28	ADC5-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC5 Data Register
0x29	ADC6-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC6 Data Register
0x2A	ADC7-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC7 Data Register
0x2B	ADC8-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC8 Data Register
0x2C	ADC9-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC9 Data Register
0x2D	ADC10-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC10 Data Register
0x2E	ADC11-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC11 Data Register
0x2F	ADC12-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC12 Data Register
0x30	ADC13-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC13 Data Register
0x31	ADC14-DATA	0x0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC14 Data Register

Figure 14. Register Map

8 Schematics and Layout

Schematics for the AMC7812EVM are appended to this user's guide. The bill of materials for the modular AMC7812EVM evaluation board is provided in Table 9.

NOTE: All components should be compliant with the European Union Restriction on Use of Hazardous Substances (RoHS) Directive. Some part numbers may be either leaded or RoHS. Verify that purchased components are RoHS-compliant. (For more information about TI's position on RoHS compliance, see the Quality and Eco-Info information on the TI web site.)

Table 9. Bill of Materials

Count	RefDes	Quantity	Description	Part Number	MFR
1	NA	1	Printed Wiring Board	6517852	TI
2	C1, C2	2	Capacitor, ceramic 1.0 µF 25V X7R 10% 0805	C2012X7R1E105K	TDK
3	C3, C4, C5, C6	4	Capacitor, ceramic 1.0 µF 16V X7R 10% 0603	C1608X7R1C105K	TDK
4	C7, C8	2	Capacitor, ceramic 1000 pF 50V 5% C0G 0603	GRM1885C1H102JA01D	Murata
5	C9	1	Capacitor, ceramic 0.47 µF 10V X5R 10% 0603	C1608X5R1A474K	TDK
6	C10 to C12, C17 to C20	7	Capacitor, ceramic 0.1 µF 50V 10% X7R 0603	GRM188R71H104KA93D	Murata
7	C13	1	Capacitor, ceramic 10 µF 16V X5R 10% 1206	C3216X5R1C106K	TDK
8	C14, C15, C16	3	Capacitor, ceramic 10 µF 10V X5R 0805	GRM219R61A106KE44D	Murata
9	D1, D2, D3, D4	4	LED 565 nM GRN Diff 0603 SMD	SML-LX0603GW-TR	Lumex
10	D5	1	LED 635 nM RED Diff 0603 SMD	SML-LX0603IW-TR	Lumex
11	J1, J3	2	18-pin, dual row, SM header (36 Pos.)	TSM-118-01-T-DV-P	Samtec
12	J2, J4	2	10-pin, dual row, SM header (20 Pos.)	TSM-110-01-T-DV-P	Samtec
13	J1B, J2B, J3B, J4B	4	10-pin, dual row, SM header (20 Pos.)	SSW-110-22-F-D-VS-K	Samtec
14	J5	1	5-pin, dual row, SM header (10 Pos.)	TSM-105-01-T-DV-P	Samtec
15	J5B	1	5-pin, dual row, SM header (10 Pos.)	SSW-105-22-F-D-VS-K	Samtec
16	J6, J7, J8, J9, J10	0	Not installed		
17	JP1, JP2, JP7	3	2-position header	TSW-102-07-T-S	Samtec
18	JP3 to JP6, JP8 to JP18	15	3-position header	TSW-103-07-T-S	Samtec
19	Q1	1	Transistor NPN GP 40V SOT23	MMBT3904-TP	Micro Commercial
20	Q2	1	Transistor SS PNP 40V 300 mW SOT23	MMBT3906-TP	Micro Commercial
21	R1 to R5, R8, R10 to R13, R20 to R23	14	Resistor, 20.0 kΩ 1/10W 1% 0603 SMD	RC0603FR-0720KL	Yageo
22	R6, R7	2	Resistor, 2.74 kΩ 1/10W 1% 0603 SMD	RC0603FR-072K74L	Yageo
23	R9, R19	2	Resistor, 0.0 Ω 1/10W 5% 0603 SMD	RC0603JR-070RL	Yageo
24	R14, R15, R16, R17, R18	5	Resistor, 330 Ω 1/8W 1% 0805 SMD	RC0805FR-07330RL	Yageo
25	TP1 to TP16, TP15 to TP18	16	Test point PC Mini .040"D Red	5000	Keystone
26	TP13, TP14, TP19 to TP21	5	Test point PC Mini .040"D Black	5001	Keystone
27	U1	1	AMC7812IRGC, AMC7812 Analog monitor and control	AMC7812IRGC	TI
28	U2	1	IC EEPROM 128 kBIT 400 kHz 8-TSSOP	24LC128-I/ST	Microchip
29	U3	1	IC Buff/Dvr Hex Non-inv 14TSSOP	SN74LVC07APWR	TI
30	NA		0.100 Shunt - Black Shunts	SNT-100-BK-T	Samtec

8.1 PCB Layout

Figure 15 illustrates the silkscreen image for the AMC7812EVM.

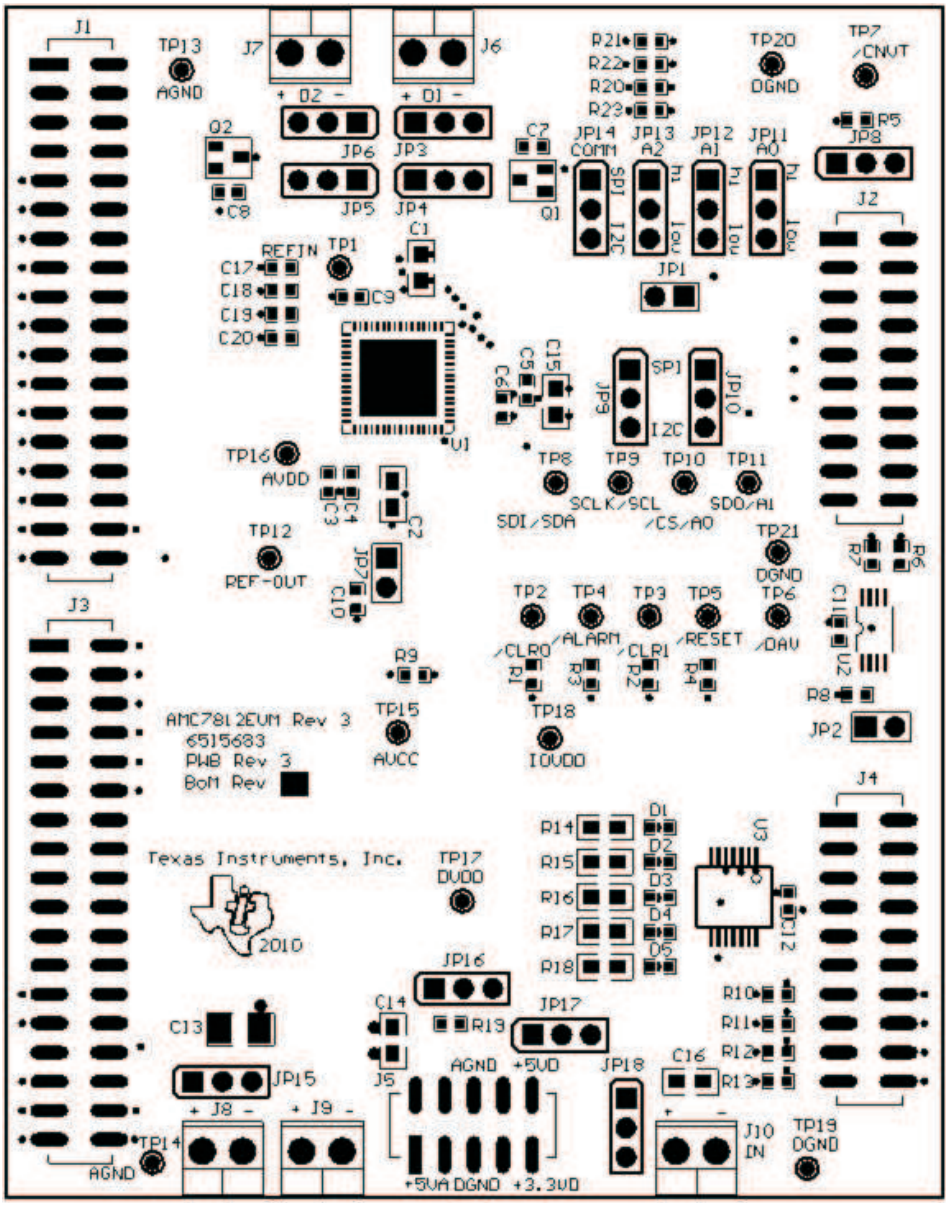


Figure 15. AMC7812EVM PCB Silkscreen

Revision History		
REV	ECN Number	Approved

U1
AMC7812IRGC
D2- / GPIO6
D2+ / GPIO7
D1- / GPIO4
D1+ / GPIO5
ADC-REF-IN/CMP
ADC-GND
CH0
CH1
CH2
CH3
CH4
CH5
CH6
CH7
CH8
CH9
CH10
CH11
CH12
CH13
CH14
CH15
DAC0-OUT
DAC1-OUT
DAC2-OUT
DAC3-OUT
DAC4-OUT
DAC5-OUT
DAC6-OUT
DAC7-OUT
DAC8-OUT
DAC9-OUT
DAC10-OUT
DAC11-OUT
REF-OUT
REF-DAC
AVCC-1
AVCC-2
AVDD-1
AVDD-2
DVDD
IOVDD
AGND1
AGND2
AGND3
AGND4
DGND2
DGND
DAC_CLR-0
DAC_CLR-1
ALARM
RESET
DAV
CNVT
SDI / SDA
SCLK / SCL
CS / A0
SDO / A1
A2
SPI / I2C
GPIO0
GPIO1
GPIO2
GPIO3
J1
Analog Input
J3
Analog Output
J2
Digital Interface
J4
Digital IO
J5
Power Interface
U2
24AA64-I/MS
U3
SN74LVC07A
J8
External 4.5V~18VDC
J9
External 2.7V~5.5VDC
J10
External 1.65V~5.5VDC
Q1
2N3904
Q2
2N3906
JP1 /CS
JP2
JP3
JP4
JP5
JP6
JP7
DAC-REF
JP8
CNVT
JP9
JP10
JP11
JP12
JP13
JP14
JP15
JP16
JP17
JP18
TP1 REFIN
TP2 /CLR0
TP3 /CLR1
TP4 /ALARM
TP5 /RESET
TP6 /DAV
TP7 /CNVT
TP8 SDI / SDA
TP9
TP10
TP11
TP12 REF-OUT
TP13 AGND
TP14 AGND
TP15 AVCC
TP16 AVDD
TP17 DVDD
TP18 IOVDD
TP19 DGND
TP20 DGND
TP21 DGND
D1 Green
D2 Green
D3 Green
D4 Green
D5 Red
IOVDD
AVCC
AVDD
DVDD
+3.3VDC
AGND
DGND
REFIN
REF-OUT
ALARM
CLR0
CLR1
RESET
SDI / SDA
SCLK / SCL
CS / A0
SDO / A1
SPI / I2C
NI
Ext
Int

TEXAS INSTRUMENTS
12500 TI Blvd. Dallas, Texas 75243

Title: AMC7812EVM			
Engineer: Wendy Fang, Kristoffer Flores			
Drawn By: Kristoffer Flores Lisa Parker	SIZE:	DATE: 11-May-2010	REV: 2
FILE:			SHEET: OF:

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For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI’s recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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